SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF
ELECTRICAL AND ELECTRONICS ENGINEERING
&
ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

III SEMESTER

1905305 – Circuit Theory
(Common to EEE and EIE)

Regulation – 2019

Academic Year 2022–2023 (ODD SEM)

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

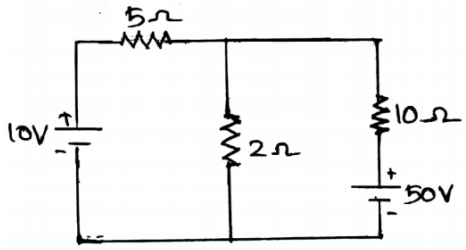
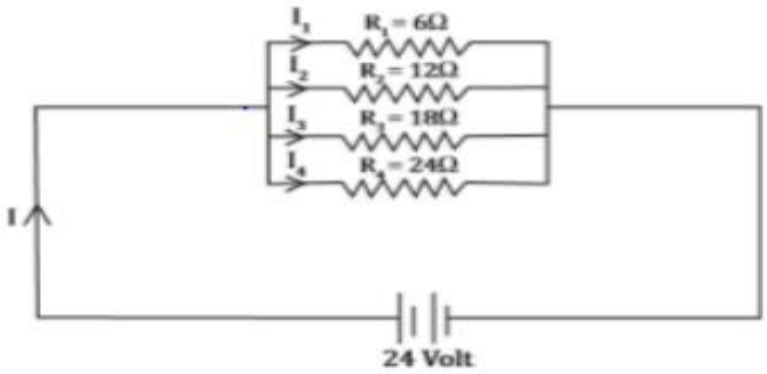
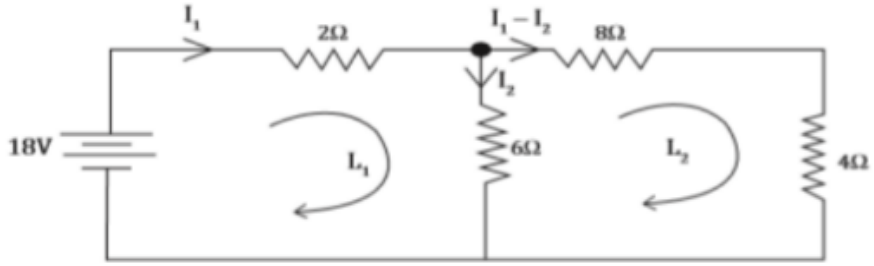
SUBJECT : 1905305-CIRCUIT THEORY **SEM / YEAR: III/II**

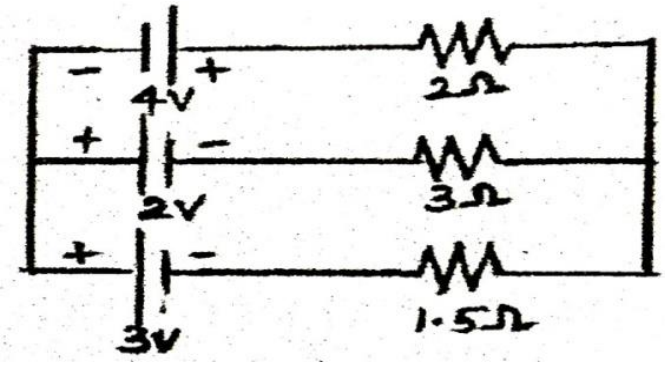
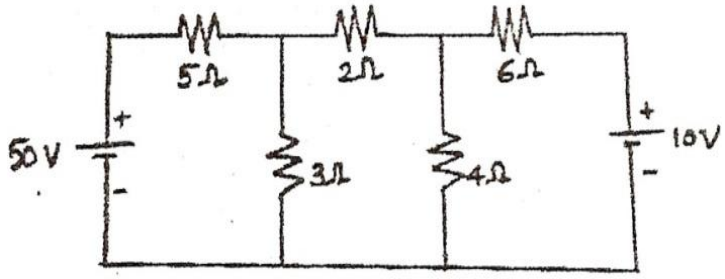
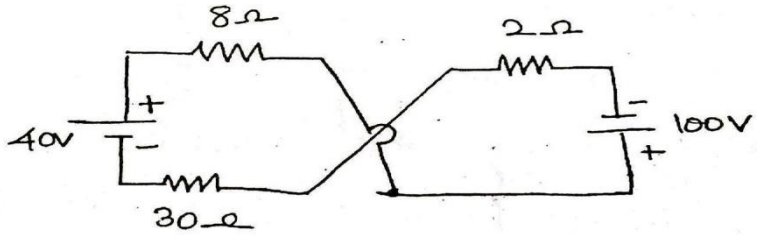
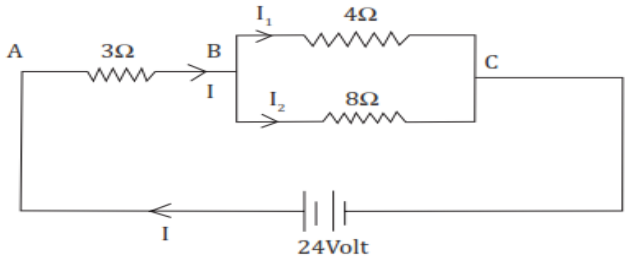
UNIT I - BASIC CIRCUITS NALYSIS

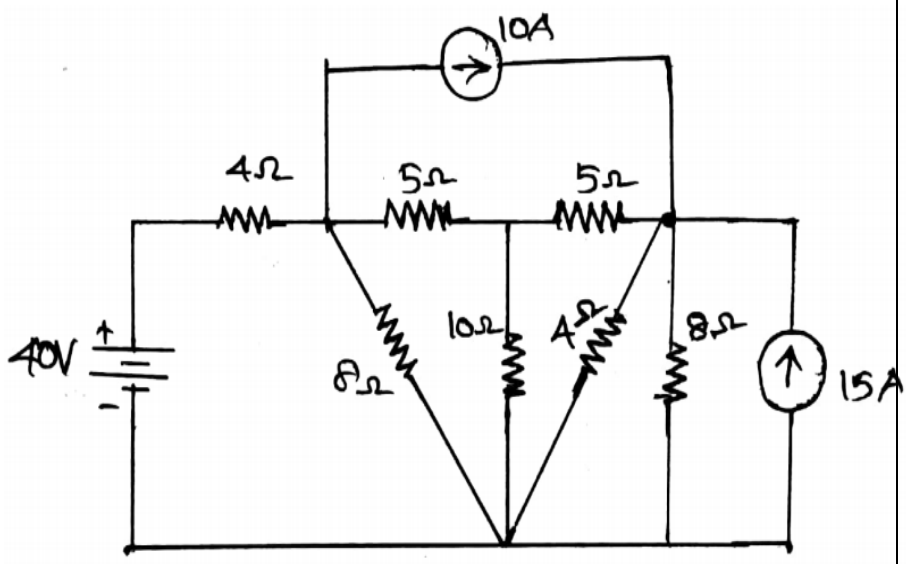
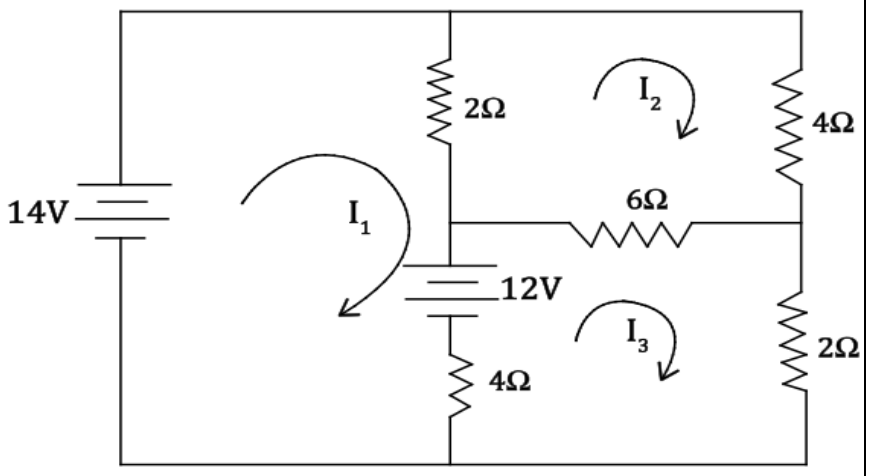
Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchhoff's laws – Mesh current and node voltage - methods of analysis.

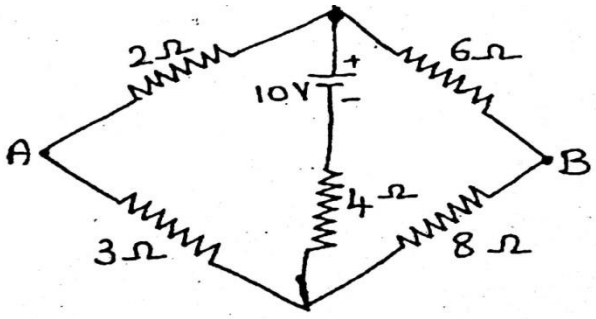
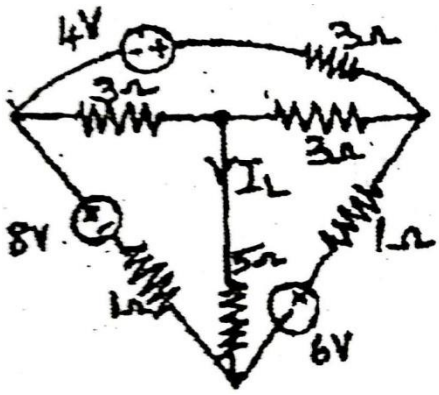
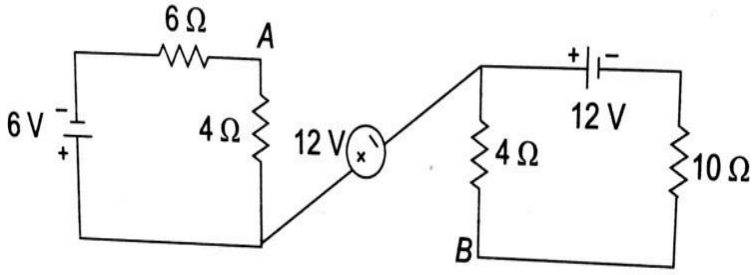
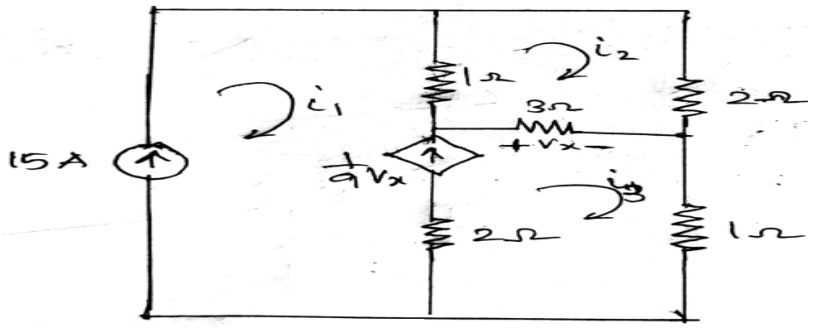
PART – A

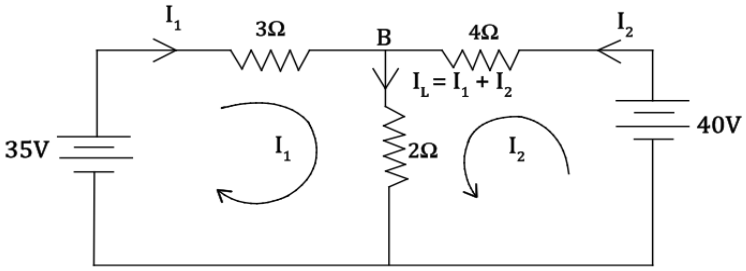
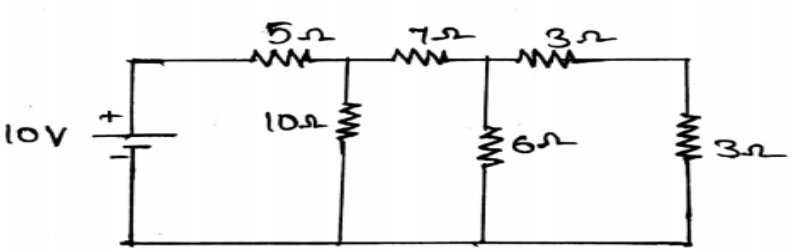
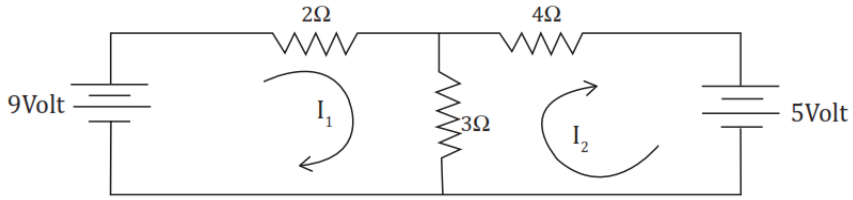
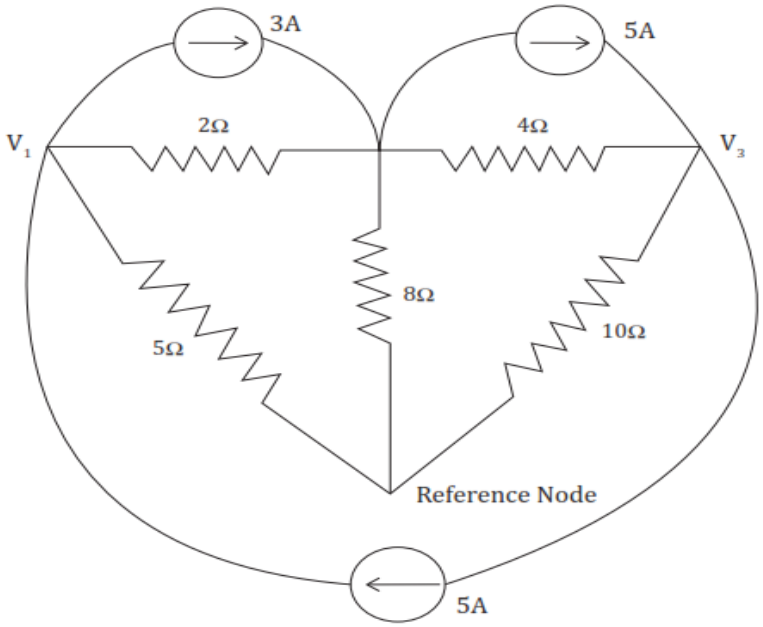
Q.No	Questions	CO	BT Level	Competence
1.	A resistor of 3.6Ω is connected in series with another of 4.56 Ω. What resistance should be connected across 3.6Ω resistor so that the total resistance of the circuit shall be 6Ω?	CO1	BTL3	**Apply**
2.	Define the terms (i) Resistance (ii) Resistivity.	CO1	BTL 1	**Remember**
3.	State Ohm's Law. Mention the limitations of Ohm's Law?	CO1	BTL3	**Apply**
4.	Two resistors 4 Ω and 6 Ω are connected in parallel. The total current flowing through the resistors is 5A. Find the current flowing through each resistor.	CO1	BTL3	**Apply**
5.	How much current flows through a conductor of resistance 20 Ohm calculate when it is supplied with a potential difference of 200 V ?	CO1	BTL3	**Apply**
6.	Define the terms (i) Mesh Analysis (ii) Nodal Analysis.	CO1	BTL 1	**Remember**
7.	Define the terms (i) Electric Current (ii) Electric Potential.	CO1	BTL 1	**Remember**
8.	How the series circuit is distinguished with parallel circuits?	CO1	BTL 2	**Understand**
9.	Two capacitance C_1, C_2 of the values 10 µF and 5 µF respectively are connected in series. Evaluate the equivalent capacitance.	CO1	BTL 5	**Evaluate**
10.	Point out the difference between DC Current with AC Current.	CO1	BTL 4	**Analyze**
11.	A Resistor of 50 Ohm has the potential difference of 100 Volts across DC supply for 1 Hour. Examine the value of (i) Current (ii) Conductance (iii) Power (iv) Energy.	CO1	BTL 5	**Evaluate**
12.	Differentiate the following terms (i) Circuit or Network (ii) Parameters (iii) Node (iv) Loop.	CO1	BTL 4	**Analyze**
13.	Two inductances L_1=3mH and L_2=6mH are connected in parallel. Analyse and infer L_{eq} .	CO1	BTL 4	**Analyze**
14.	What is meant by inductor ? Formulate the voltage, current, power and energy formulae for inductor.	CO1	BTL 6	**Create**
15.	Generalize the expressions for mesh current equations in matrix form.	CO1	BTL 6	**Create**
16.	Estimate the resultant resistance produced by the parallel connection of two resistors of 10Ω and 30Ω.	CO1	BTL 4	**Analyze**
17.	Express the formulae for 3-Resistors in Series and Parallel.	CO1	BTL 2	**Understand**

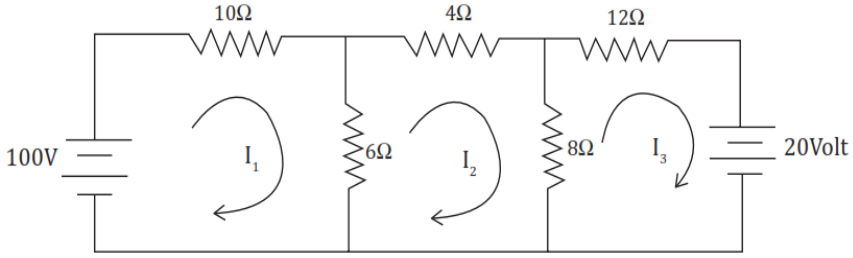
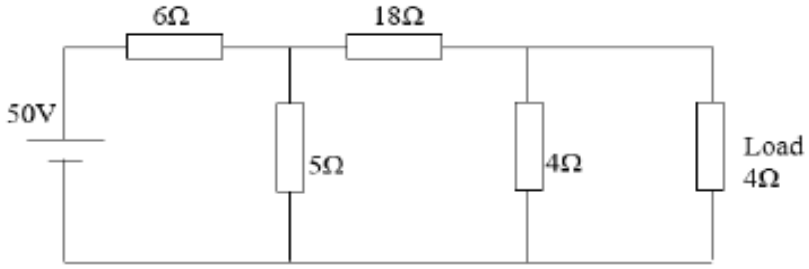
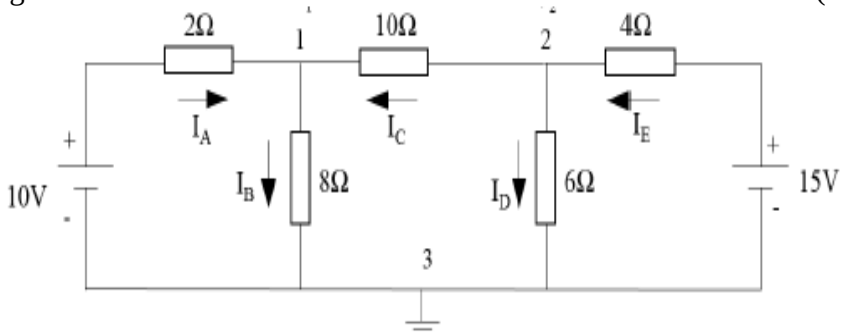
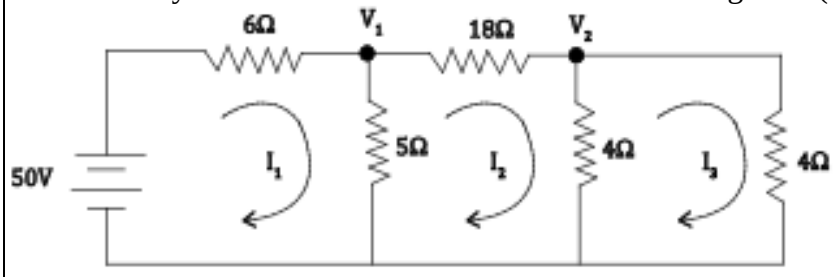
18.	Write the mesh current equation in the circuit shown in figure and determine the currents. 	CO1	BTL 1	**Remember**
19.	What is meant by Resistor ? Illustrate the formulae for (i) Voltage (ii) Current (iii) Power (iv) Energy Formulae for Resistor.	CO1	BTL 3	**Apply**
20.	What is meant by capacitor ? Write the voltage, current, power and energy formulae for capacitor.	CO1	BTL 2	**Understand**
21.	State Kirchhoff's Current Law and Voltage Law.	CO1	BTL 1	**Remember**
22.	Two resistances when connected in series, the effective value of resistance are 100 Ohms. When connected in parallel the effective value is 24. Formulate the value of resistance R_1 and R_2.	CO1	BTL 3	**Apply**
23.	Define the terms (i) active elements (ii) passive elements.	CO1	BTL 1	**Remember**
24.	State ideal voltage source and current source.	CO1	BTL 1	**Remember**
	PART – B			
1.	(i) The Four resistors 6Ohms,12 Ohms,18 Ohms and 24 Ohms are connected in parallel with 24 Voltage supply. Calculate (i) Current through the branch of network (ii) Supply Current (iii) Total resistance of the circuit. (6) 	CO1	BTL 3	**Apply**
	(ii) Derive the expressions for the resistance in (i) Series Circuit (ii) Parallel Circuit. (7)	CO1	BTL 4	**Analyze**
2.	Find the value (i) Current supplied through each resistor (ii) Voltage drop across 3 Ohm Resistor (iii) Power delivered by 3 Ohm resistor. (13) 	CO1	BTL 3	**Apply**

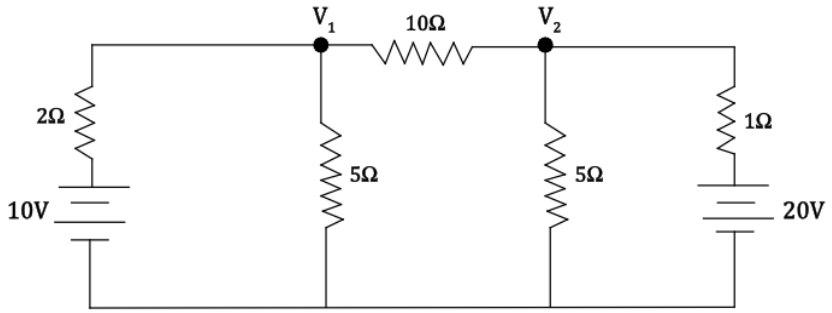
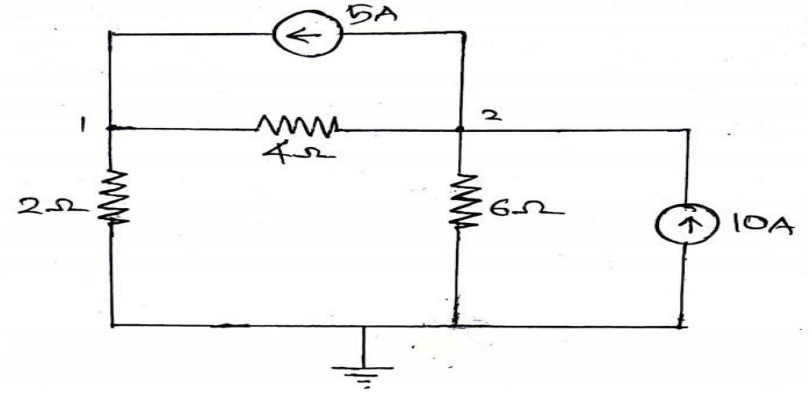
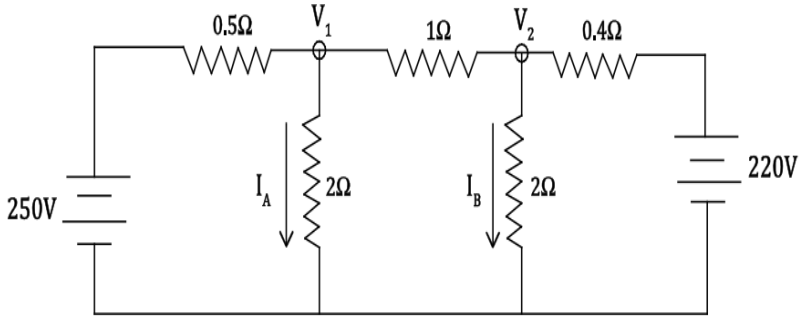
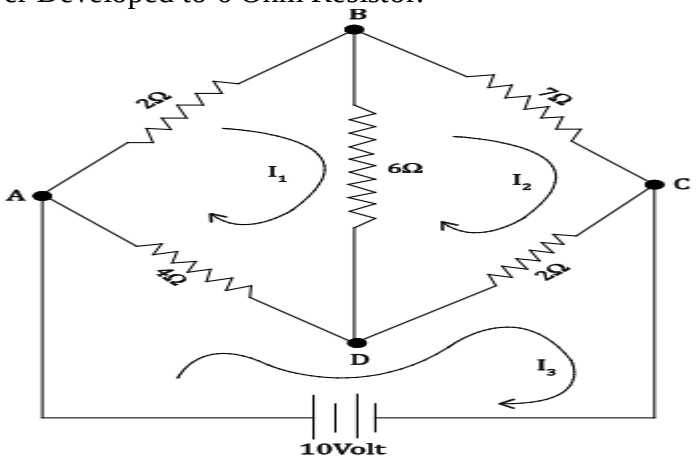
3.	**(i).** Determine the magnitude and direction of the current in the 2 V battery in the circuit. (6)  **(ii).** Determine the power dissipation in the 4Ω resistor of the given circuit shown in Fig. (7)  	CO1 CO1	BTL 4 BTL 4	**Analyze** **Analyze**
4.	**(i)** Find the current I and voltage across 30 Ω of the circuit shown in Fig. (7)  **(ii)** The Three resistors resistances of 3 Ohm, 4 Ohm, 8 Ohm are connected as shown in Fig. Across 24 Volts battery. Formulate (1) Total Effective Resistance in the circuit (2) Current supplied by the battery (3) Current flow through each resistor. (6)  	CO1 CO1	BTL 3 BTL 6	**Apply** **Create**

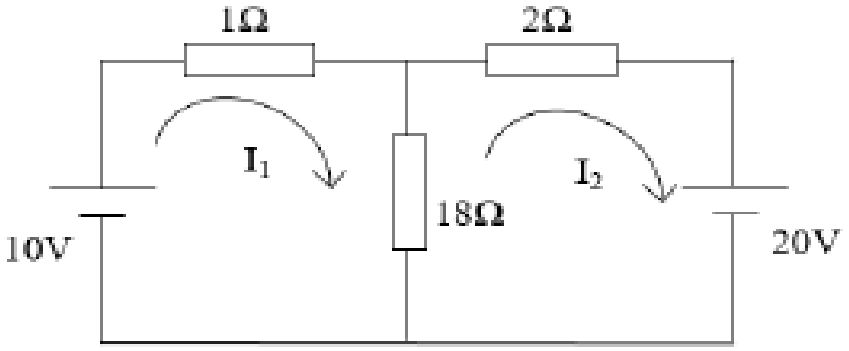
5.	Use Nodal Voltage method and estimate the power dissipated in the 10 Ω resistance on the circuit shown in the Fig. (13) 	CO1	BTL 2	**Understand**
6.	**(i)** Distinguish between series and parallel circuits. (6) **(ii)** Two 50 ohms resistors are connected in series .When a resistor R is connected across one of them, the total circuit resistance is 60 ohms. Calculate the value of R. If the supply voltage across the above circuit is 60V,find the current passing through individual resistance. (7)	CO1 CO1	BTL 4 BTL 3	**Analyze** **Apply**
7.	Illustrate the Loop currents I_1, I_2 and I_3 by Mesh loop analysis as shown in Fig. (13) 	CO1	BTL 3	**Apply**

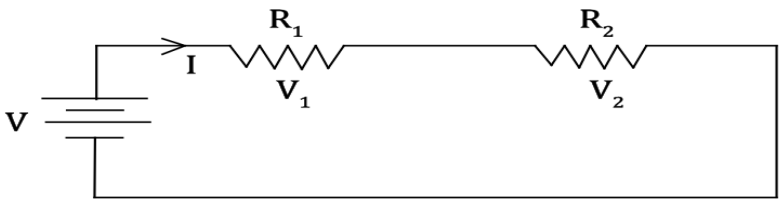
8.	For the circuit shown in Fig, Evaluate the (i) currents in different branches (ii) current supplied by the battery (iii) potential difference between terminals A and B. (13) 	CO1	BTL 5	**Evaluate**
9.	**(i)** Determine the current I_L in the circuit shown in Fig. (7) 	CO1	BTL 4	**Analyze**
	(ii) Estimate the voltage across A and B in the circuit shown in Fig. (6) 	CO1	BTL 2	**Understa nd**
10.	Analyze the mesh analysis to the circuit shown in Fig. and Find voltage across the dependent source. (13) 	CO1	BTL 4	**Analyze**

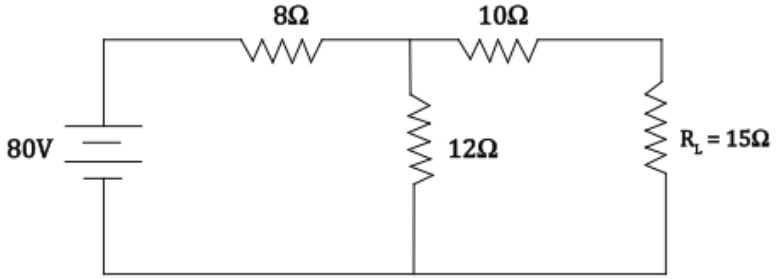
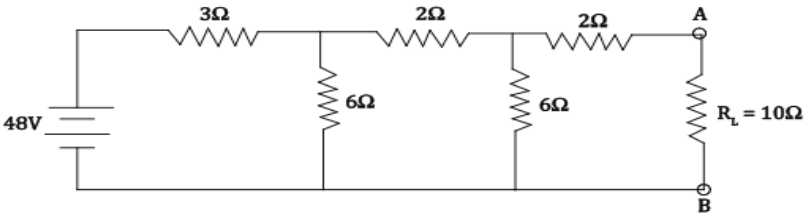
11.	**(i)** State Kirchhoff's Current Law (KVL) and Kirchhoff's Voltage Law(KVL). (4) **(ii)** Calculate the value of (1) Load Current and Current supplied by the Battery (2) Voltage at the Load Current (3) Power developed by the Load. (9) 	CO1 CO1	BTL 1 BTL 3	**Remember** **Apply**
12.	**(i)** Determine the current I delivered by the source. (7)  (ii) Calculate the value of Loop or Mesh Current I_1 and I_2 for the given circuit as shown in Fig. (6) 	CO1 CO1	BTL 6 BTL 3	**Create** **Apply**
13.	Calculate the value of Nodal Voltages V_1, V_2 and V_3 by Nodal Analysis Method as shown in Fig (13) 	CO1	BTL 3	**Apply**

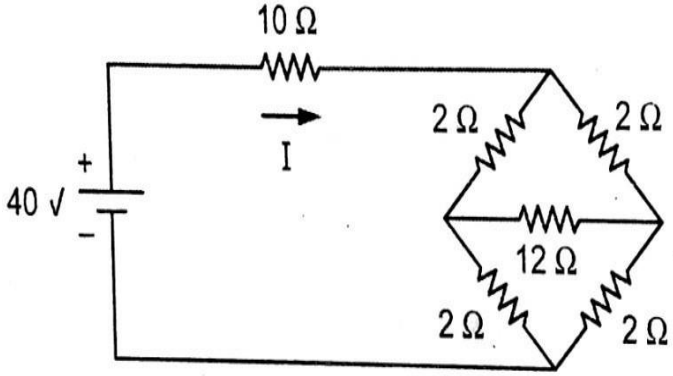
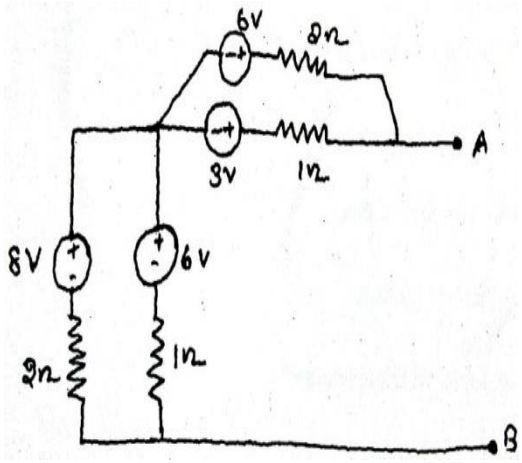
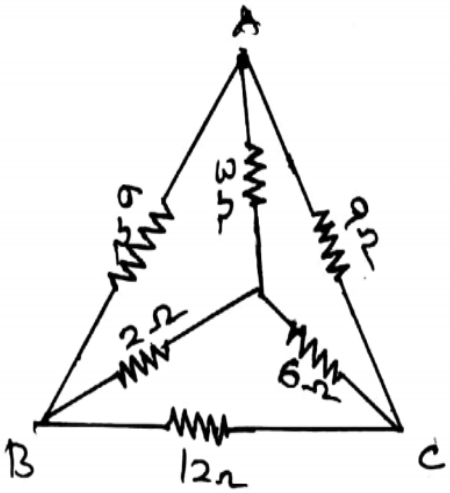
14.	**(i)** State and explain Kirchoff's laws. (4)	CO1	BTL1	**Remember**
	(ii) Derive the Loop currents I_1, I_2 and I_3 by Mesh loop analysis and also Find power dissipated by 8 Ohm resistor as shown in Fig.(9) 	CO1	BTL 3	**Apply**
15.	Find the value of current through 4Ω load resistor using mesh current analysis. (13) 	CO1	BTL 3	**Apply**
16.	Find by nodal analysis, the current I_A and I_C in the circuit as shown in Fig. (13) 	CO1	BTL 3	**Apply**
17.	A wheat stone bridge consists of AB=10Ω, BC=10Ω, CD=4Ω, DA=5Ω. A galvanometer of resistance 20Ω is connected across BD. Evaluate the current through the galvanometer when a p.d of 10V is maintained across AC. (13)	CO1	**BTL 5**	**Evaluate**
	PART-C			
1.	Justify (i) V_1 and V_2 by Nodal Analysis (ii) I_1, I_2 and I_3 by Loop or Current Analysis Method for the network as shown in Fig. (15) 	CO1	**BTL 5**	**Evaluate**

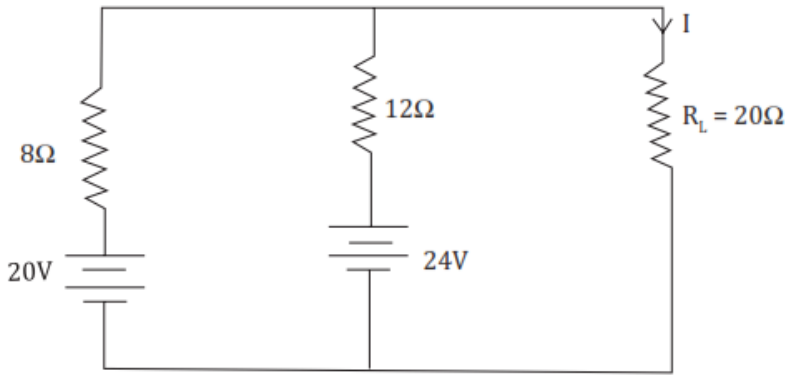
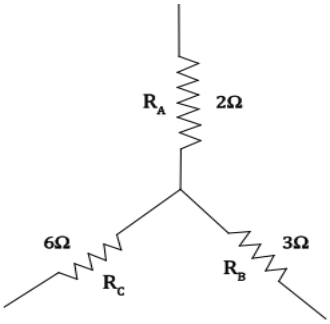
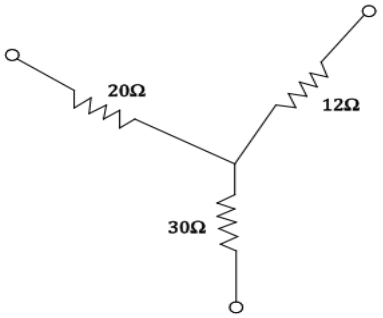
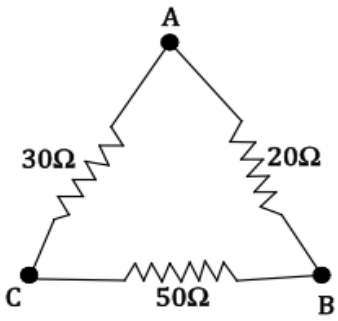
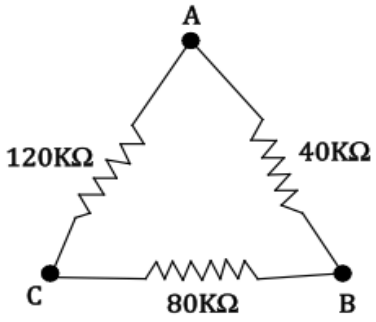
2.	(i) By Nodal Voltages Analysis Method, Derive and formulate the value of V_1, V_2 and V_3 as shown in Fig. (10) 	CO1	**BTL 6**	**Create**
	(ii) Evaluate the node voltage in the circuit. (5) 	CO1	**BTL 5**	**Evaluate**
3.	Find the values of V_1 and V_2 and I_A and I_B by Nodal analysis method as shown in Fig. (15) 	CO1	**BTL 3**	**Apply**
4.	The Wheat Stone Bridge Circuit as shown in Fig. . Judge Loop currents I_1, I_2, I_3 and also (i) Voltage across 6 Ohm Resistor (ii) Power Developed to 6 Ohm Resistor. (15) 	CO1	**BTL 5**	**Evaluate**

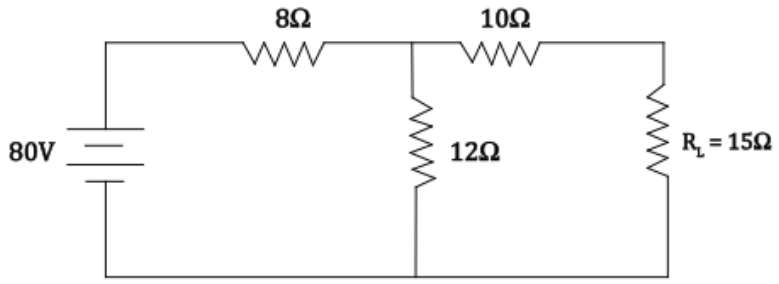
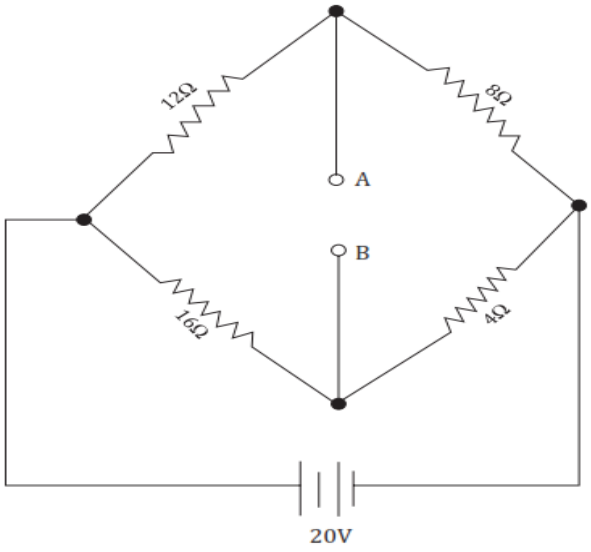
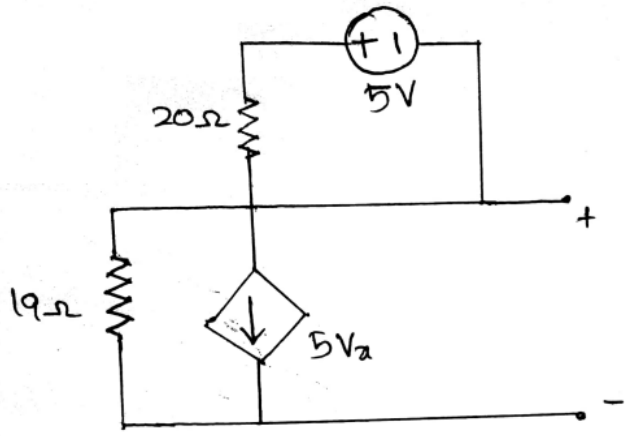
5.	Find the current through 18Ω resistor in the given circuit using mesh current analysis. (15) 	CO1	**BTL 3**	**Apply**

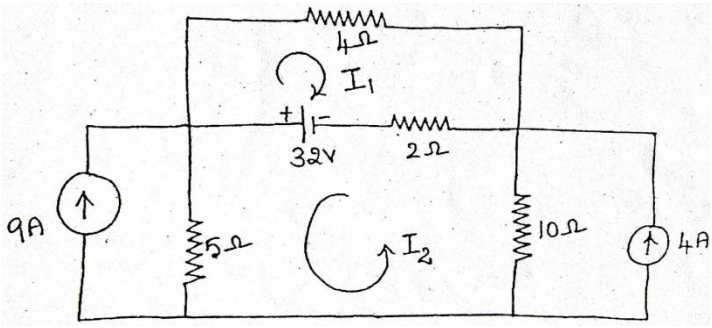
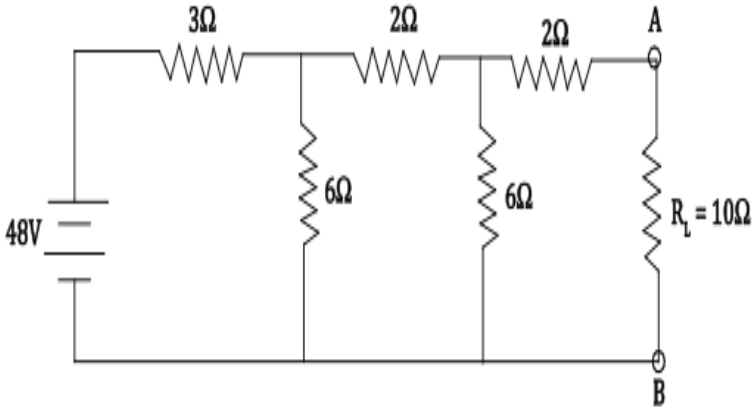
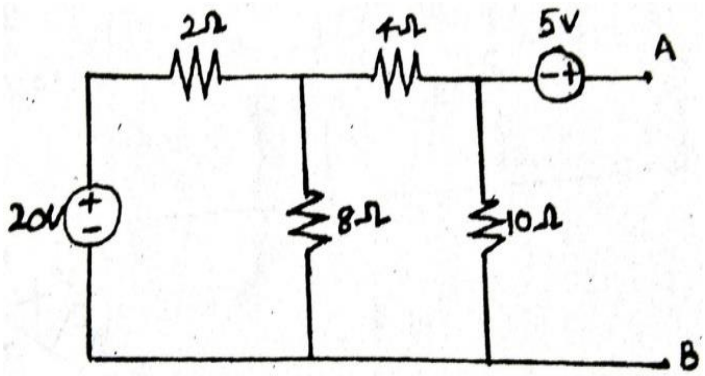
UNIT II - NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS				
Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.				
PART – A				
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	Distinguish linear and nonlinear elements with suitable example for each. .	CO2	BTL 3	**Apply**
2.	Define the terms (i) Electric circuit (ii) Electric network.	CO2	BTL 3	**Apply**
3.	Illustrate the equivalent voltage source for a current source of 15A when connected in parallel with 5 ohm resistance	CO2	BTL 3	**Apply**
4.	Given that the resistors R_a, R_b and R_c are connected electrically in star. Formulate the equations for resistors in equivalent delta	CO2	BTL 3	**Apply**
5.	Three resistors R_{ab}, R_{bc} and R_{ca} are connected in delta. Re-write the expression for resistors in equivalent star.	CO2	BTL 6	**Create**
6.	Write the formulae for voltage division rule with suitable circuit.	CO2	BTL 2	**Understand**
7.	Write the formulae for current division rule with suitable circuit.	CO2	BTL 5	**Evaluate**
8.	Draw the circuit of a practical voltage source and its equivalent current source	CO2	BTL 1	**Remember**
9.	For the given circuit, apply voltage division rule and Find the values of V_1 and V_2. 	CO2	BTL 3	**Apply**
10.	Express Thevenin's Theorem.	CO2	BTL 5	**Evaluate**

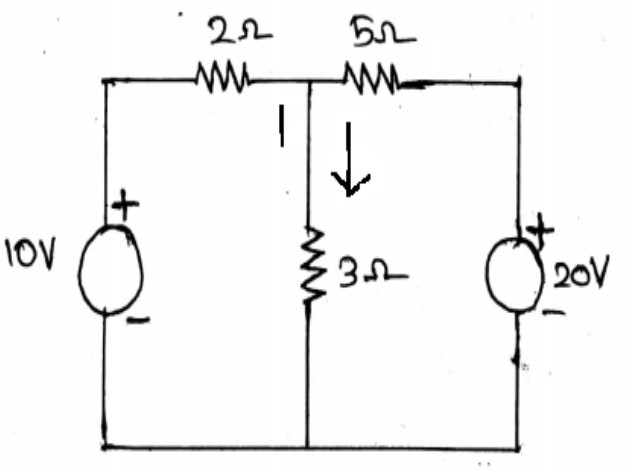
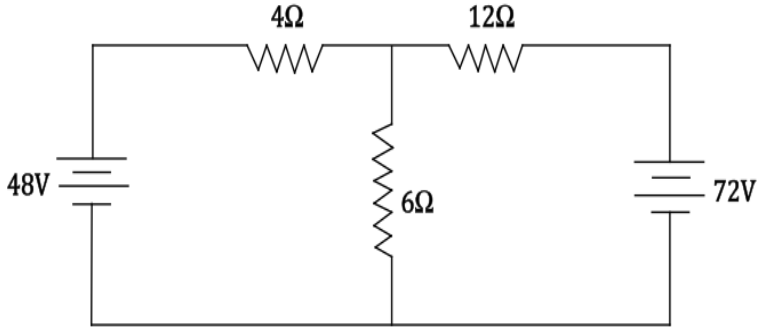
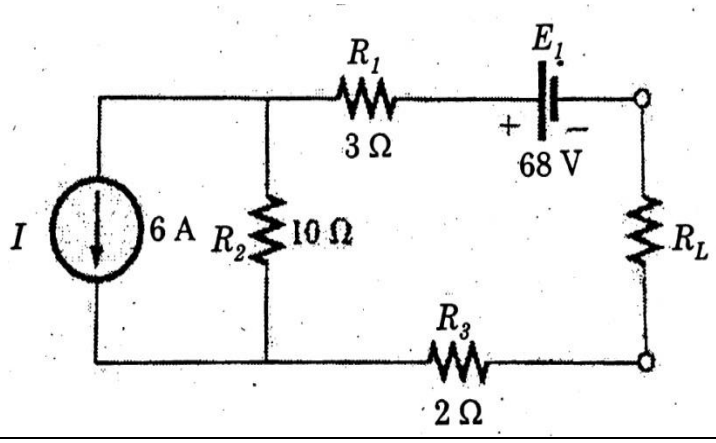
11.	A load is connected to a network of the terminals to which load is connected in which R_{th}=10 Ohms and V_{th}=40 Volts. Calculate the maximum power supplied to the load.	CO2	BTL 3	**Apply**
12.	State reciprocity theorem.	CO2	BTL 1	**Remember**
13.	Is reciprocity theorem applied to the circuit having resistors, capacitors and diodes? Give your reason.	CO2	BTL 4	**Analyze**
14.	State Superposition theorem.	CO2	BTL 1	**Remember**
15.	List out the applications of maximum power transfer theorem.	CO2	BTL 1	**Remember**
16.	Distinguish between DC Current and AC Current.	CO2	BTL 4	**Analyze**
17.	What is the condition for maximum power transfer in DC and AC circuits?	CO2	BTL 2	**Understand**
18.	A load is connected to a network of the terminals to which load is connected, R_{th}=10 ohms and V_{th}=40 Calculate the maximum power supplied to the load.	CO2	BTL 3	**Apply**
19.	State Millman's theorem.	CO2	BTL 1	**Remember**
20.	State Reciprocity theorem.	CO2	BTL 1	**Remember**
21.	State Norton's theorem.	CO2	BTL 1	**Remember**
22.	Mention the different types of dependent source.	CO2	BTL 1	**Remember**
23.	What is the condition for maximum power transfer in DC Circuit.	CO2	BTL 3	**Apply**
24.	State Maximum power theorem.	CO2	BTL 4	**Analyze**
	PART – B			
1.	State Maximum power transfer theorem and derive the conditions for maximum power transfer in a single source circuit. (13) 	CO2	BTL 4	**Analyze**
2.	Using Thevenin's theorem, Evaluate the current through R_L=10 Ohm as shown in Fig. .and Find power developed by Load. (13) 	CO2	BTL 3	**Apply**

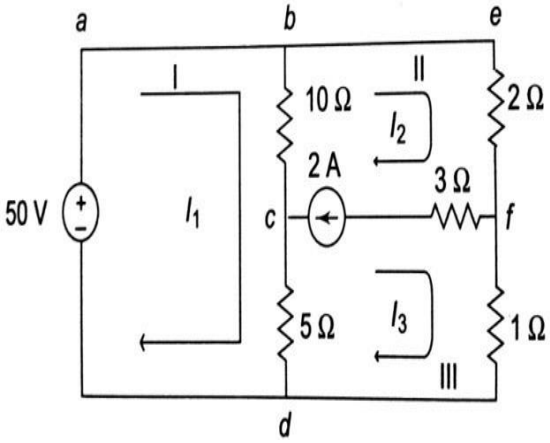
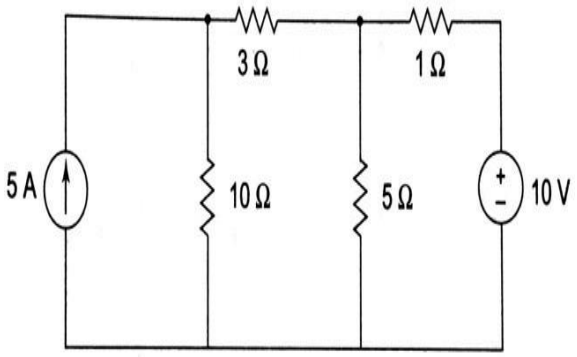
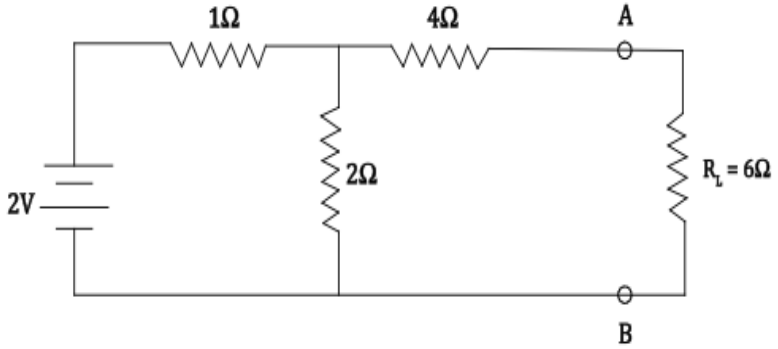
3.	**(i)** Simplify the circuit and predict out the current flowing through the 10Ω resistor, for the circuit diagram shown in Fig. (8)  **(ii)**Using source transformation technique, Simplify the network shown in Fig. (5)  	CO2 CO2	BTL 2 BTL 2	**Understand** **Understand**
4.	**(i)** In the circuit of figure six resistors are connected to form delta and a star. Formulate the effective resistance between A and B. (7)  	CO2	BTL 6	**Create**

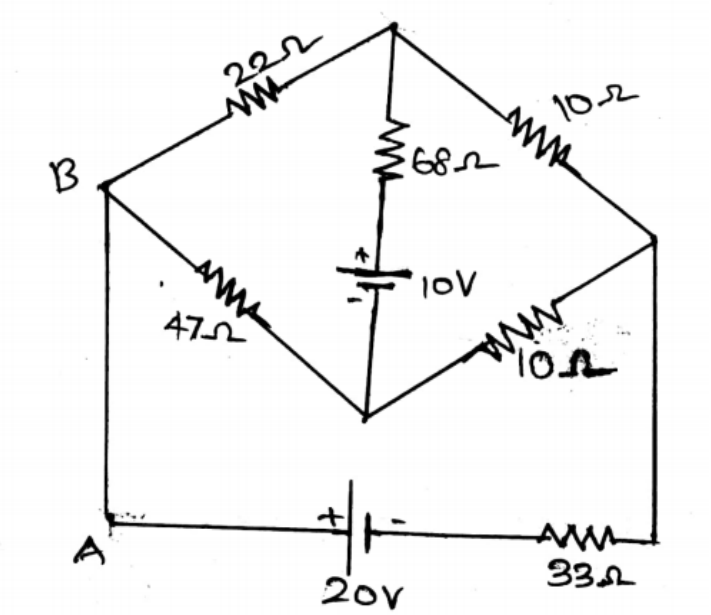
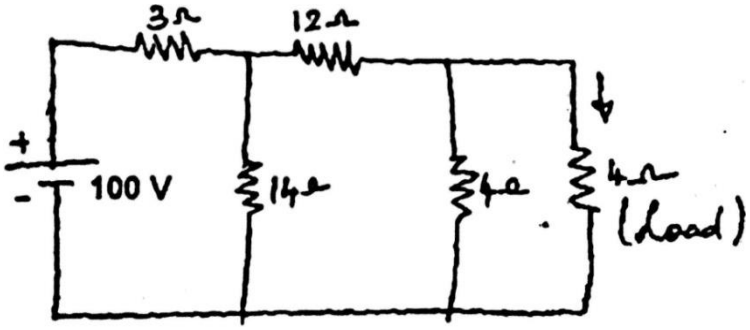
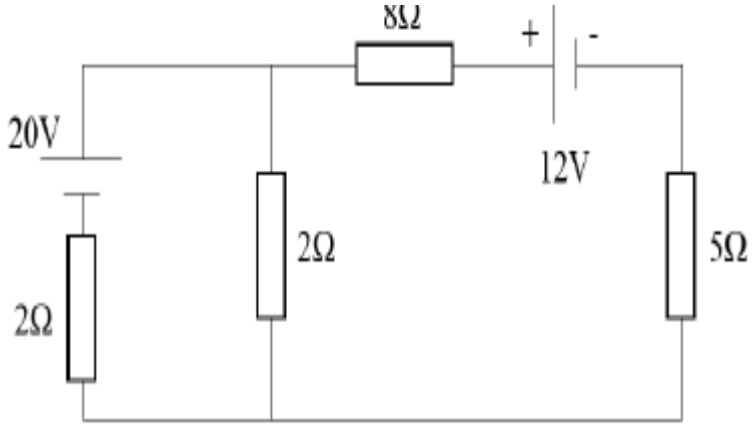
	(ii) For the circuit, using Thevenin's Theorem, Find (1) Open Circuit voltage across AB Terminal (2) Thevenin's Resistance across AB (3) Load Current (4) Load Power as shown in Fig. (6) 	CO2	BTL 3	**Apply**
5.	**(i)** Analyze the following Star network into Delta network as shown in Fig.(7)  	CO2	BTL 4	**Analyze**
	(ii) Analyze the following network Delta into Star network and find the value as shown in Fig. (6)  	CO2	BTL 4	**Analyze**

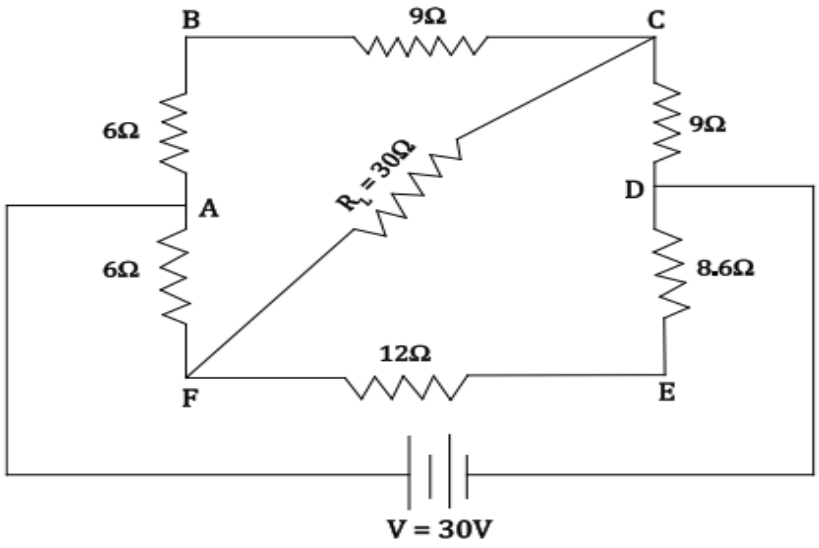
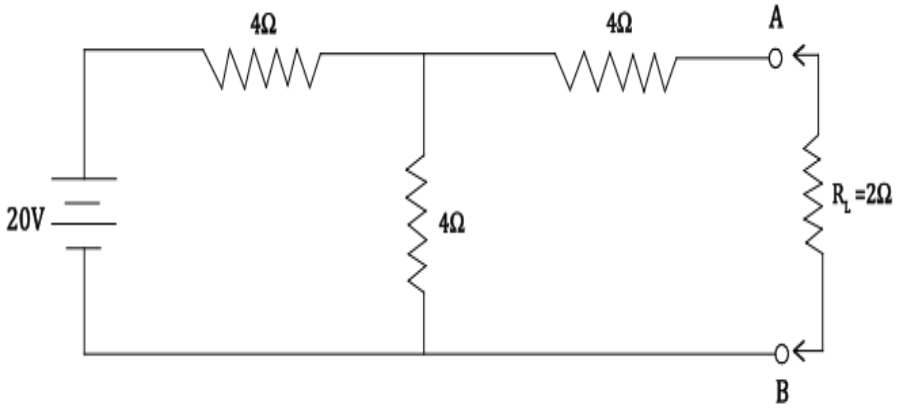
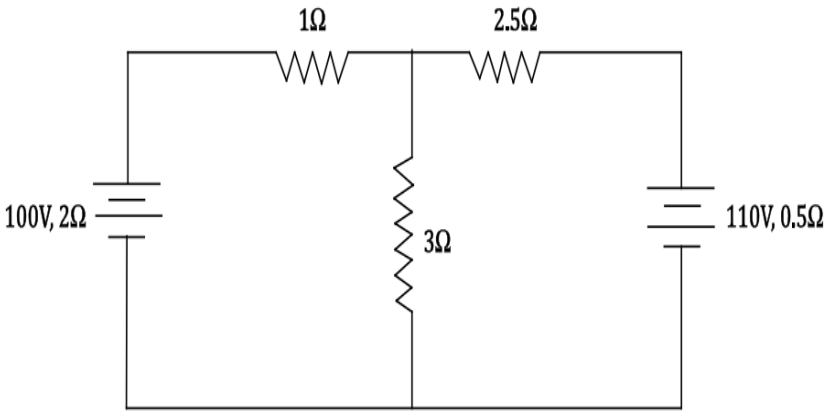
6.	**(i)** By applying Norton's Theorem, Find the current through 15 Ohm as shown in Fig. (7) 	CO2	BTL 3	**Apply**
	(ii) Find the Power developed by 2 Ohm resistor connected between AB by Norton's Theorem as shown in Fig. (6) 	CO2	BTL 3	**Apply**
7.	Determine the Thevenin's and Norton's equivalent circuit of the network. (13) 	CO2	BTL 4	**Analyze**

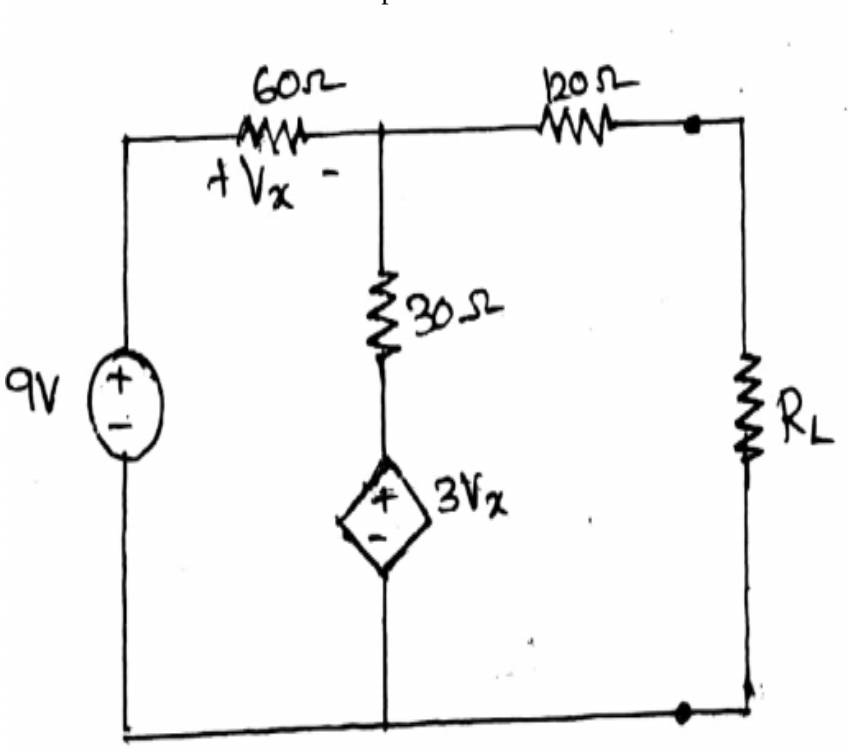
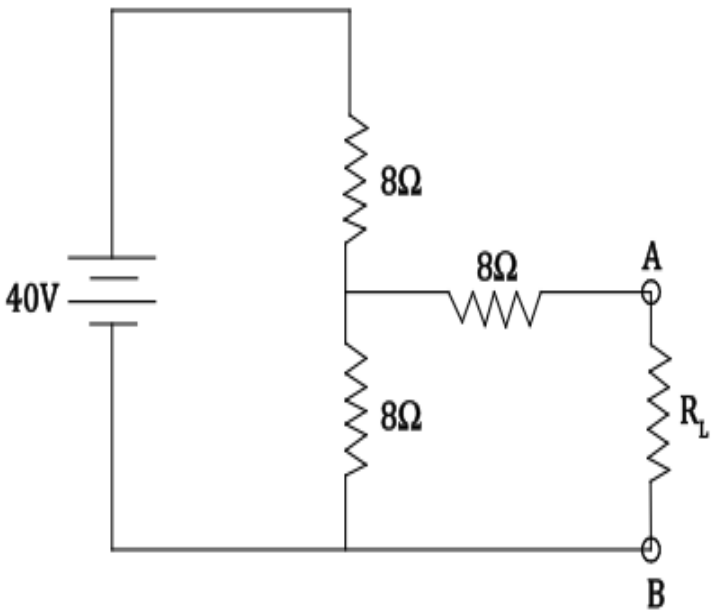
8.	Estimate the current through 5 Ω resistor using superposition theorem, in the circuit shown in Fig. (13) 	CO2	BTL 5	**Evaluate**
9.	**i)** Briefly explain Reciprocity and Millman theorem with neat diagram. (7) **ii)**Using Thevenin's theorem, Evaluate the current through R_L=10 Ohm as shown in Fig. . and Find power developed by Load. (6) 	CO2 CO2	BTL 1 BTL 5	**Remember** **Evaluate**
10.	**(i)** Determine the value of resistance that may be connected across A and B so that maximum power is transferred from the circuit to the resistance shown in Fig. (9)  **(ii)** Calculate the current I shown in figure using Milman's theorem. (4)	CO2 CO2	BTL4 BTL 3	**Analyze** **Apply**

				
11.	**(i)** Find the magnitude and direction of current flow through 6 Ohm Resistor by Superposition Theorem as shown in Fig. (7) 	CO2	BTL 5	**Evaluate**
	(ii) Find the value R_L in the fig for maximum power to R_L and calculate the maximum power**.** (6) 	CO2	BTL 3	**Apply**

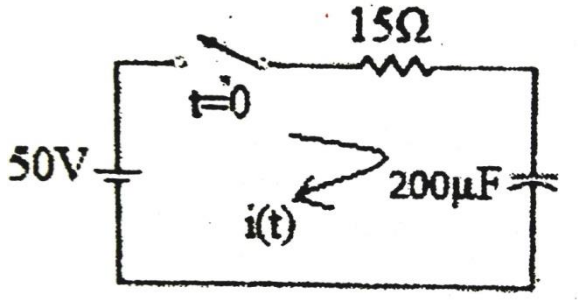
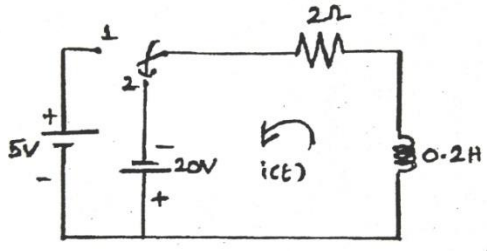
12.	**(i)** Examine and identify the current in the 5Ω resistor in the network given in Fig. **(7)**  **(ii)** Find out the current in each branch of the circuit shown in Fig.(6)  	CO2 CO2	BTL 6 BTL 3	**Create** **Apply**
13.	**(i)** Prove the Reciprocity Theorem for the above problem as shown in Fig. (13)  	CO2	BTL 3	**Apply**

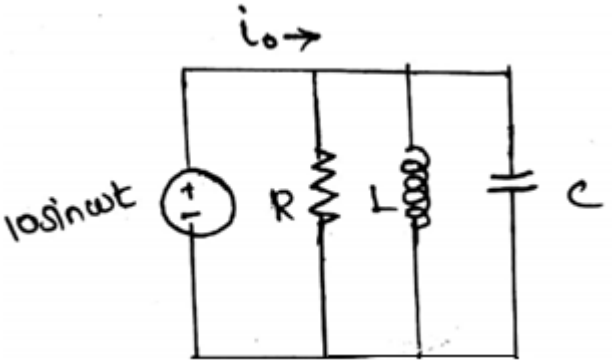
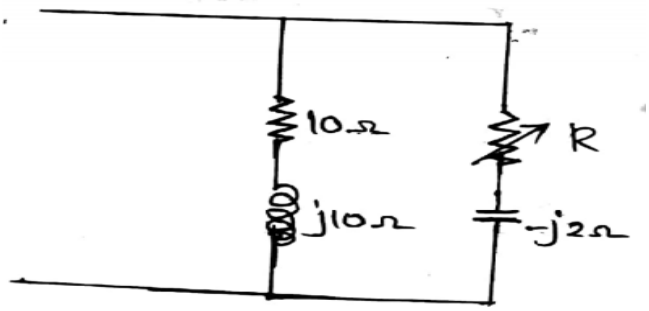
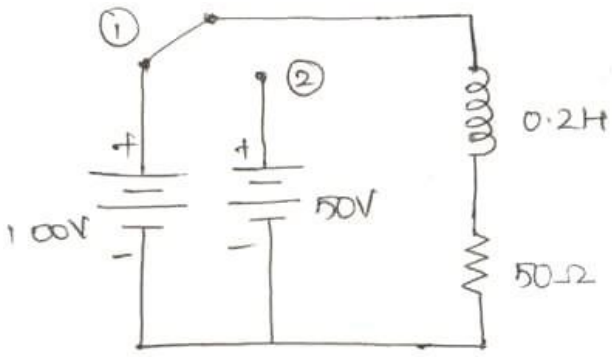
14.	**(i)** Find the power delivered by the 20 V Source using superposition theorem. (7)  **(ii)** Verify Reciprocity theorem for the circuit below. (6) 	CO2 CO2	BTL 3 BTL 4	**Apply** **Analyze**
15.	State and explain Milliman's theorem with an example.		BTL 2	**Understand**
16.	Determine the current flowing through 5Ω resistor by using Thevenin's theorem. 		BTL 3	**Apply**
17.	State and explain Superposition theorem with an example.		BTL 2	**Understand**

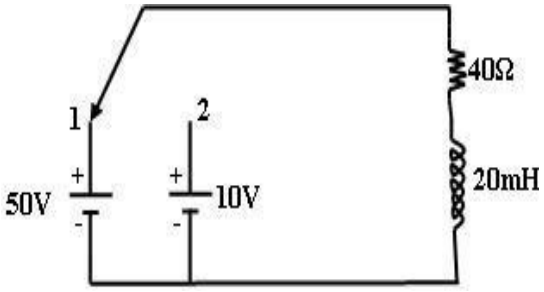
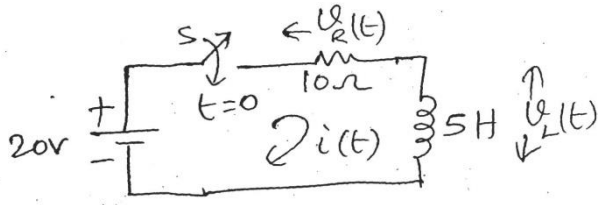
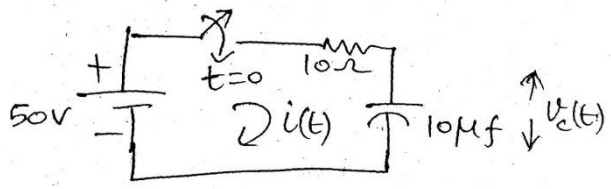
	PART-C			
1.	By applying Thevenin's Theorem Calculate (i) Thevenin's voltage across FC (ii) Thevenion's Resistance between FC (iii) Load Current for the circuit as shown in Fig. in which R_L=30 Ohm. (15) 	CO2	**BTL 5**	**Evaluate**
2.	Prove Thevenin's Theorem and Norton's Theorem for the given problem as shown in Fig. (15) 	CO2	**BTL 6**	**Create**
3.	By Super Position Theorem and Reciprocity Theorem Find the current flow through 3 Ohm Resistor as shown in Fig. (15) 	CO2	**BTL 5**	**Evaluate**

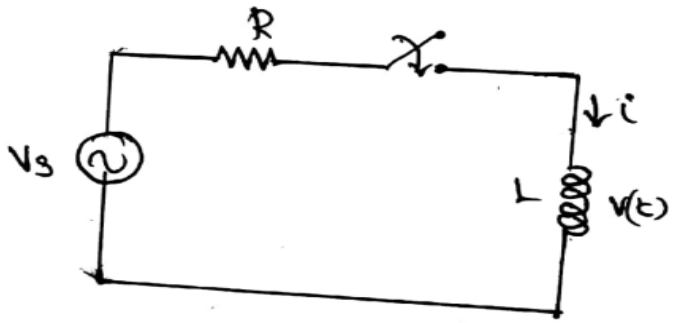
4.	**(i)** Determine the value of R_L that will draw maximum power from the rest of the circuit. Calculate the maximum power. (7)  	CO2	**BTL 5**	**Evaluate**
	(ii) Evaluate Maximum power transfer for the given problem as shown in Fig(8).  	CO2	**BTL 5**	**Evaluate**
5.	Derive the equations needed for (i) Delta to Star transformation (ii) Star to Delta transformation.	**CO2**	BTL 5	**Evaluate**

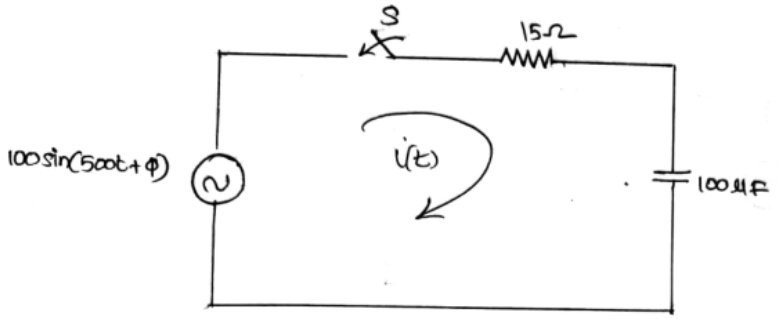
UNIT III - TRANSIENT RESPONSE ANALYSIS				
L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.				
PART – A				
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	In a series RLC circuit, L=2H and C= 5μF. Calculate the value of R to give critical damping.	**CO3**	BTL 3	**Apply**
2.	What is the time constant for series RL and RC circuits?	**CO3**	BTL 2	**Understand**
3.	Distinguish between transient response and steady state response of a circuit.	**CO3**	BTL 2	**Understand**
4.	Generalize the frequency response of series RLC circuit.	**CO3**	BTL 5	**Evaluate**
5.	Define the term 'Time Constant'. And write formulae for R_L, R_C Circuit.	**CO3**	BTL 1	**Remember**
6.	Write Integral-differential equation of RLC Circuit with the supply voltage E.	**CO3**	BTL 1	**Remember**
7.	Classify the periodic inputs.	**CO3**	BTL 4	**Analyze**
8.	Define (i) transient response (ii) Exponential decay response. Write the formulae for RL Transient Response	**CO3**	BTL 1	**Remember**
9.	Distinguish between free and forced response.	**CO3**	BTL 2	**Understand**
10.	Illustrate the time constant of RL Circuit having the resistance R=10 Ohm and L=0.1mH.	**CO3**	BTL 3	**Apply**
11.	Define the terms (i) Transient Time (ii) Time Constant (iii) Natural response (iv) Steady state response.	**CO3**	BTL 1	**Remember**
12.	Develop an equivalent circuit for inductor and capacitor at t=0+ when there is no initial energy.	**CO3**	BTL 6	**Create**
13.	A DC Voltage of 100 Volts is applied to Series RL Circuit with R=25 Ohm. Calculate the value of current in which time constant is twice.	**CO3**	BTL 3	**Apply**
14.	Analyze the current given by $I(t) = 5 - 4e^{-20t}$	**CO3**	BTL 4	**Analyze**
15.	Define time constant for RL circuit. Draw the transient current characteristics.	**CO3**	BTL 1	**Remember**
16.	Sketch the transient response of I, V_R,V_L in Series RL Circuit.	**CO3**	BTL 1	**Remember**
17.	Describe about under damping.	**CO3**	BTL 2	**Understand**
18.	Draw the phasor diagram for a pure inductor	**CO3**	BTL 3	**Apply**
19.	State the expression for capacitive reactance and its unit.	**CO3**	BTL 2	**Understand**
20.	State the relationship between frequency and period.	**CO3**	BTL 2	**Understand**

		CO3	BTL 5	**Evaluate**
21.	Calculate the time constant for series RLC circuit?	**CO3**	BTL 3	**Apply**
22.	Let a RL circuits has 50Ω and 1mHelements and free of source but,the inductor has initial current of 1 mA at time $t=0^-$s.Find the voltage across the resistor at time $t=\infty$	**CO3**	BTL 3	**Apply**
23.	Find the time constant of RL Circuit with R=100 Ohms and L=20 mH?	**CO3**	BTL 3	**Apply**
24.	Define instantaneous value of a.c voltage	**CO3**	BTL 1	**Remember**
	PART – B			
1.	A sinusoidal voltage of 10sin100t is connected in series with a switch and R=10Ω and L=0.1H.If the switch is closed at t=0, Determine the transient current i(t). (13)	**CO3**	BTL 6	**Create**
2.	In the circuit shown, determine the transient current after switch is closed at time t=0, given that an initial charge of 100μC is stored in the capacitor. Derive the necessary equations. (13) 	**CO3**	BTL 4	**Analyze**
3.	In the RL circuit shown in fig, the switch is closed to position 1 at t=0. After t=100ms, the switch is changed to position 2.Find i(t) and sketch the transient. (13) 	**CO3**	BTL 6	**Create**

4.	**(i)** Obtain the expression for resonant frequency and bandwidth for a series RLC resonant circuit. (7) **(ii)**In the parallel RLC circuit of Fig, let R=8kΩ, L=0.2 mH and C=8μF. Calculate ω_0,Q , half power frequencies and BW. (6) 	**CO3** **CO3**	BTL 4 BTL 3	**Analyze** **Apply**
5.	**(i)**Calculate Q of the series RLC circuit with R=10Ω,L=0.04H and C-I μF. Find bandwidth, resonant frequency and half power frequencies. (7) (ii)For the parallel network shown in figure, determine the value of R for resonance. (6) 	**CO3** **CO3**	BTL 3 BTL 3	**Apply** **Apply**
6.	In the series circuit shown in Fig., the switch is closed on position 1 at t=0.At t=1 milli second, the switch is moved to position 2 .Obtain the equations for the current in both intervals. (13) 	**CO3**	BTL 4	**Analyze**

7.	**(i)** A series RC circuit with R=5 KΩ and C=20uF as a constant voltage source of 100V applied at t=0; there is no initial charge on the capacitor. Examine the current i and charge q for t > 0. (7) **(ii)** In the circuit given below, the switch has been in position 1 for sufficient time to establish steady state conditions. The switch is then moved to position 2. Show the current transient. (6) 	**CO3** **CO3**	BTL 1 BTL 3	**Remember** **Apply**
8.	Derive the transient response of series R-L-C circuit, with DC input, using Laplace transform. **(i)** Derive the necessary differential equation and solve. (3) **(ii)** Discuss the cases of over-damping,critical–damping and under-damping**.** (5) **(iii)** Express the solution in terms of underdamped natural frequency, damped natural frequency anddampingfactor. (3) **(iv)** Sketch the transient response curve for three cases. (2)	**CO3**	BTL 2	**Understand**
9.	**(i)** In the circuit shown in fig, find the expression for i(t),V_R(t) and V_L(t) if the switch is closedatt=0**.** (7)  **(ii)** In the circuit shown in fig, find the value of current 'i' at t=50μS if the switch is closed at t=0 andV_C(t=0)=0. (6) 	**CO3** **CO3**	BTL 3 BTL 3	**Apply** **Apply**
10.	Derive the expression of Series RC Transient with a DC voltage applied through it obtain Current, Voltage, Power, Energy produced and Decay transient of the circuit. (13)	**CO3**	BTL 2	**Understand**
11.	Analyze the expression for current transient when series RL circuit is excited by a sinusoidal source $v=V_m(\sin \omega t)$ at t=0. (13)	**CO3**	BTL 4	**Analyze**

12.	Consider a source free parallel RLC circuit and evaluate the voltage response of the circuit on different damping conditions. (13)	**CO3**	BTL 5	**Evaluate**
13.	A series RL circuit with R=10 Ω and L=0.1 H is supplied by an input voltage $V_s(t)$= 10 sin 100t Volts applied at t=0 as shown in fig. Calculate the current i, voltage across inductor. Derive the necessary expression and plot the respective curves. (13) 	**CO3**	BTL 3	**Apply**
14	A series RLC circuit with R=50Ω, L=0.1H and C=50uF as a voltage of 100V applied to it at t=0 through a switch. Evaluate the expression for a current transient. Assume initially relaxed circuit conditions**.** (13)	**CO3**	BTL 5	**Evaluate**
15.	Derive the expression for transient response of RL series circuit excited by DC voltage. (13)	**CO3**	BTL 4	**Analyze**
16.	A coil of resistance 8Ω and an inductance of 0.1 H is connected in series with a capacitance of 75 μF with a voltage of 240V, 50Hz. Calculate (i) inductive reactance (ii) capacitive reactance (iii) impedance (iv) current (v) power factor (vi) power in the circuit. (13)	**CO3**	BTL 3	**Apply**
17.	Derive the expression for transient response of RC series circuit excited by DC voltage. (13)	**CO3**	BTL 3	**Apply**
	PART-C			
1.	A coil of resistance 10Ω and an inductance of 0.1 H is connected in series with a capacitance of 150μF with a voltage of 200V, 50Hz supply. Calculate (i) inductive reactance (ii) capacitive reactance (iii) impedance (iv) current (v) power factor (vi) voltage across the coil and capacitor. (15)	**CO3**	**BTL 5**	**Evaluate**
2.	Derive the expression for the RL Transient response and R.L Decay Response for the DC Source Excitation. (8) (ii) In Series RL Circuit with R=100 Ohms and L=20 Henry has a DC Voltage of 200 Volts applied through a switch at t=0. Find (i) Current and Voltage across each element (ii) Current at time t=0.5 Seconds (iii) Current at time t=1 Second (iv) Time at which $e_R=e_L$.(7**)**	**CO3** **CO3**	**BTL 5** **BTL 6**	**Evaluate** **Create**
3.	(i) Evaluate the Laplace Transform for the following Functions (i) Step Function (ii) Exponential Function (iii)Sine Function (iv)Cosine Function (v) Power of t. (8) (ii) Define Laplace Transform. Explain the following theorems (i) Initial value Theorem (ii) Final value Theorem and explain with Mathematical Representation (5)	**CO3** **CO3**	**BTL 5** **BTL 5**	**Evaluate** **Evaluate**

4.	The circuit consists of a series RC elements with R=15Ω and C=100μF.A sinusoidal voltage V=100sin(500t+Ø) volts is applied to the circuit at time corresponding to Ø=45^0.Obtain the current transient. (15)  	**CO3**	**BTL 5**	**Evaluate**
5.	Derive the expression for transient response of RLC series circuit excited by DC voltage. (15)	**CO3**	**BTL 5**	**Evaluate**

UNIT IV - <u>THREE PHASE CIRCUITS</u>

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy. Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phasecircuits.

PART – A

Q.No.	Questions	CO	BT Level	Competence
1.	Point out the advantages of 3-phase system over 1phase system.	**CO4**	**BTL 4**	**Analyze**
2.	Assess the various methods of power measurement in 3Φ circuits	**CO4**	**BTL 5**	**Evaluate**
3.	Define (i) Average value (ii) RMS value (iii) Crest factor (iv)Form factor.	**CO4**	**BTL 1**	**Remember**
4.	Evaluate the voltage across Y and B in a 3 Φ balanced delta system with voltage across R and Y is $400\angle 0^0$ V. Assume RYBphase	**CO4**	**BTL 5**	**Evaluate**
5.	Distinguish between unbalanced source and unbalanced load.	**CO4**	**BTL 2**	**Understand**
6.	A 3Φ 400V supply is given to a balanced star connected load of impedance 8+j6 ohms in each branch. Formulate the line current.	**CO4**	**BTL 6**	**Create**
7.	Define power factor in terms of impedance and power components.	**CO4**	**BTL 2**	**Understand**
8.	Define form factor. What is the value of Form factor for sinusoidal signal.	**CO4**	**BTL 3**	**Apply**
9.	Calculate the power factor if $V(t)=V_m\sin\omega t$ and $I(t)=I_m\sin(\omega t-45^0)$.	**CO4**	**BTL 3**	**Apply**
10.	Evaluate the formulae for two watt meter method for the measurement of power.	**CO4**	**BTL 4**	**Analyze**

11.	Compare star and delta connected system.	**CO4**	**BTL 4**	**Analyze**
12.	Define average value and RMS value.	**CO4**	**BTL 1**	**Remember**
13.	Define power factor.	**CO4**	**BTL 1**	**Remember**
14.	Describe the terms (i) Line voltage (ii) Line current .	**CO4**	**BTL 2**	**Understand**
15.	Differentiate active and reactive power in electrical circuits.	**CO4**	**BTL 2**	**Understand**
16.	How do you differentiate Power and Energy in ElectricalCircuits?	**CO4**	**BTL 1**	**Remember**
17.	Draw the phasor diagram of voltages derived from a 3phase source.	**CO4**	**BTL 6**	**Create**
18.	Distinguish between balanced supply and unbalanced load.	**CO4**	**BTL 2**	**Understand**
19.	In a reactive circuit, the current leads the voltage by angle 45°. Find whether the resultant reactive is either inductive or capacitive and power factor.	**CO4**	**BTL 3**	**Apply**
20.	Write the expression for determining reactive and apparent power in a three phase circuit.	**CO4**	**BTL 1**	**Remember**
21.	Define the terms : Phase and Phase difference.	**CO4**	**BTL 1**	**Remember**
22.	What are the three types of power in AC Circuits ?	**CO4**	**BTL 2**	**Understand**
23.	Define Phasor diagram	**CO4**	**BTL 1**	**Remember**
24.	What is the phase sequence of a three phase system?	**CO4**	**BTL 2**	**Understand**

PART – B

1.	(i) A symmetrical three phase three wire 440V supply to a star connected load. The impedance in each branch are 2+j3Ω,1-j2Ω and 3+j4Ω. Find its equivalent delta connected load. (7)	**CO4**	**BTL 3**	**Apply**
	(ii) A three phase balanced delta-connected load of 4+j8Ω is connected across a 400V, 3Ø balanced supply. Determine the phase currents and line currents (Phase sequence inRYB). (6)	**CO4**	**BTL 3**	**Apply**
2.	**(i)** A symmetrical three phase ,three wire 400 V supply is connected to a delta-connected load .Impedances in each branch are $Z_{RY}=10\angle 30^0\Omega$, $Z_{YB}=10\angle 45^0\Omega$ and $Z_{BR}=2.5\angle 60^0\Omega$. Find Equivalent star-connected load.(7)	**CO4**	**BTL 3**	**Apply**
	(ii) A balanced star connected load having an impedance 15+j20Ω per phase is connected to 3Ø,440V, 50Hz.Find the line current and power absorbed by the load. (6)	**CO4**	**BTL 3**	**Apply**
3.	**(i)** A 3-phase balanced delta-connected load of (4+j8) Ω is connected across a 400V,3-phase supply. Determine the phase currents and line currents. Assume the RYB phase sequence. Also calculate the value of the power drawn by the load. (7)	**CO4**	**BTL 3**	**Apply**
	(ii) Three equal inductors connected in star, take 5kW at 0.7pf when connected to a 400V,50Hz, three phases ,three wire supply. Calculate the line currents (1) if one of the inductors is disconnected (2) if one of the inductors is shortcircuited. (6)	**CO4**	BTL 2	**Understand**

4.	Discuss in detail about the three phase 3-wire circuits with (i) Star connected balanced loads (ii) Delta balanced Loads. (13)	**CO4**	BTL 1	**Remember**
5.	Explain three phase power measurement by 2 wattmeter method for star and delta connected load and determine the power equation and draw the phasor diagram. (13)	**CO4**	BTL 4	**Analyze**
6.	**(i)** A 400V (line to line) is applied to three star connected identical impedances each consisting of a 4 Ω resistance in series with 3 Ω inductive reactance. Find **(1)** line current and **(2)** total power supplied. (7) **(ii)** Three star connected impedances Z_1= (20+j37.7) Ω per phase are in parallel with three delta-connected impedance Z_2= (30-j159.3) Ω per phase. The line voltage is 398 volts. Find the line current, power factor, power and reactive volt-ampere taken by the combination**.** (6)	**CO4** **CO4**	BTL 3 BTL 3	**Apply** **Apply**
7.	The two wattmeter produces wattmeter readings P_1=1560W and P_2=2100W When connected to delta connected load. If the line voltage is 220V,Calculate (1)the per phase average power (2) total reactive power. (3) Power factor (4) the phasor impedance. Is the impedance inductive or Capacitive?Justify. (13)	**CO4**	BTL 3	**Apply**
8.	Explain the following Three Phase Loads for Balanced and Unbalanced Loads for (i) Star Connected Loads (ii)Delta Connected Loads. (7) **(i)** Determine the line current, power factor and total power when a 3- phase 400V supply is given to a balanced load of impedance(8+j6) Ω in each branch is connected instar. (6)	**CO4** **CO4**	BTL 2 BTL 3	**Understand** **Apply**
9.	Discuss the method of measuring power in a three phase system with balanced and unbalanced load conditions. (13)	**CO4**	BTL 1	**Remember**
10.	**(i)** A delta connected balanced load is supplied from 3 phase 400V Supply. The line current is 20 A, total power taken by load is 10,000 Examine the impedance in each branch, the line current, power factor and total power consumption**.** (7) **(ii)** Unbalanced four wire star connected load has balanced supply voltage of 400V. The load impedances are Z_R= (4+j8) Ω, Z_Y= (3+j4) Ω, Z_B=(15++j10) Ω. Examine line currents, neutral current and total power. (6)	**CO4** **CO4**	BTL 5 BTL5	**Evaluate** **Evaluate**
11.	Explain the measurement of power in 3 phase circuit using one wattmeter method. (13)	**CO4**	BTL 5	**Evaluate**
12.	(i) Mention the Merits of Three Phase System compare with Single Phase System. (6) (ii) Explain the following connection wiring for Three Phase Systems (1)Interconnection of Winding (2) Star Connection (3) Delta Connection with Phasor Diagram. (7)	**CO4** **CO4**	BTL 1 BTL 2	**Remember** **Understand**
13.	Determine the amplitude of the line current in a 3Ø system with a 300V line voltage that supplies 1200W to a Y connected load at lagging PF of 0.8. (13)	**CO4**	BTL 4	**Analyze**
14.	Derive the relationship between the phase voltage and line voltage of a 3 phase star connected balanced system. (13)			
15.	Calculate the total power input and readings of the two wattmeter's connected to measure power in a three phase balanced load, if the reactive power input is 15 KVAR, and the load pf is 0.8**.** (13)	**CO4**	BTL 5	**Evaluate**

16.	Explain the power and power factor measuring in the three phase by two wattmeter method. (13)	**CO4**	BTL 5	**Evaluate**
17.	Two wattcmeters in three phase three wire system with an effective line voltage of 120 volts reads 1500 watts and 500 watts. Find the impedance of the balanced delta connected load. (13)	**CO4**	**BTL 3**	**Apply**
	PART-C			
1.	A 400V, three phase supply feeds an unbalanced three wire, star connected load. The branch impedances of the load are $Z_R=(4+j8)\Omega$; $Z_Y=(3+j4)\Omega$ and $Z_B=(15+j20)\Omega$. Find the line currents and voltage across each phase impedance. Assume RYB phase sequence. (15)	**CO4**	BTL 5	**Evaluate**
2.	(i) Explain the following connection wiring for Three Phase Systems (i) Interconnection of Winding (ii) Star Connection (iii) Delta Connection with Phasor Diagram. (8) (ii)A balanced Star connected load of (4+j3)Ohm /Phase is connected to a 3-Phase,230 V,50 Hz Supply. Evaluate (i) Line Current (ii) Power Factor (iii) Reactive volt Amperes (iv) Power in VA. (7)	**CO4** **CO4**	BTL 2 BTL 5	**Understand** **Evaluate**
3.	Explain the following methods for the Three Phase Power Measurement Methods (i) Three Watt meter Method (ii) Two Wattmeter Method (iii) One Wattmeter Method. (15)	**CO4**	BTL 5	**Evaluate**
4.	Consider a series RLC circuit is energized by a sinusoidal signal source (assume amplitude of A_m and frequency of φ). (i) What would be the instantaneous and average power delivered by source. (ii)What would be the instantaneous and average power dissipated by elements R,L and C**.** (15)	**CO4**	BTL 6	**Create**
5.	Two wattcmeters used to measure the input to a balanced three phase circuit indicate 2000 watts and 500 watts respectively. Find the power factor of the circuit (i) when both wattcmeters are positive (ii) When the later is obtained after reversing in the connection to the current coil of one instrument. (15)	**CO4**	BTL 3	**Apply**

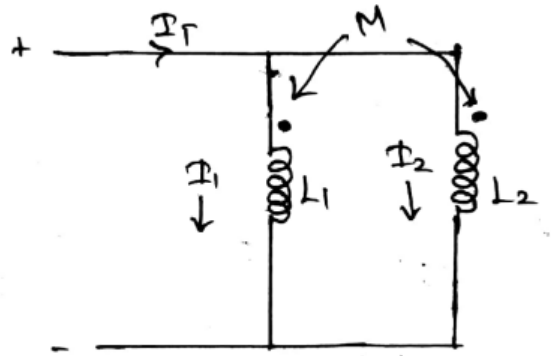
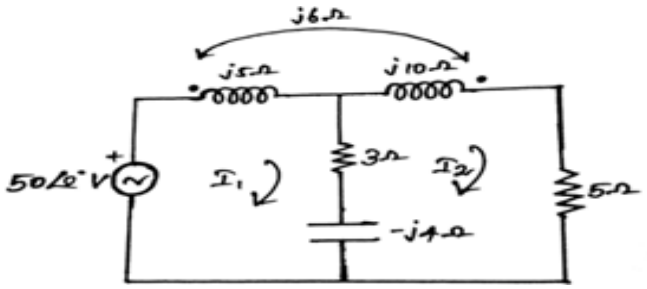
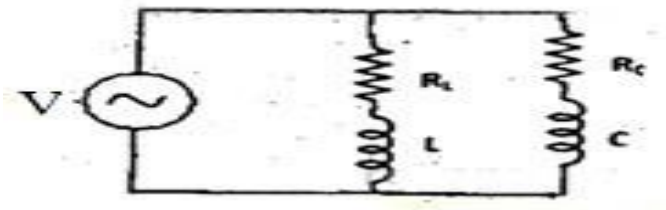
UNIT V - <u>RESONANCE AND COUPLED CIRCUITS</u>

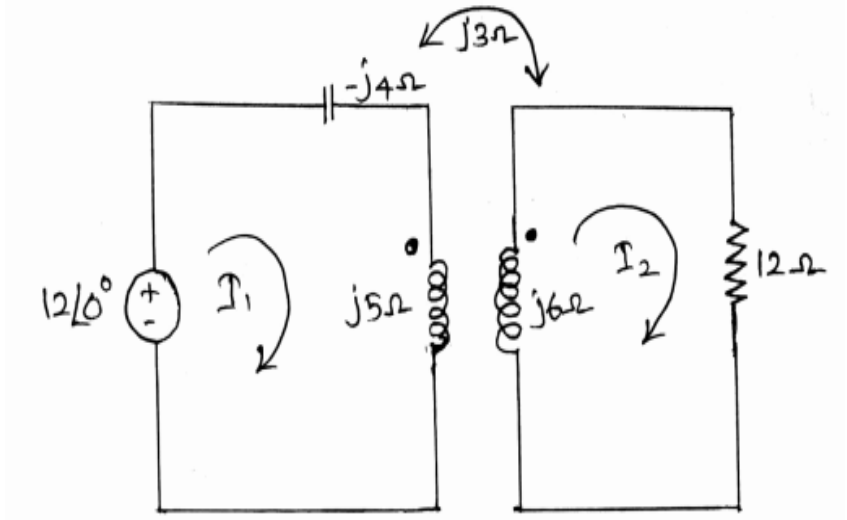
Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

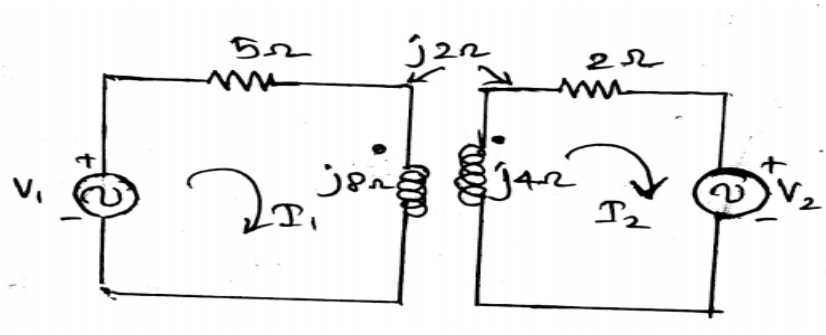
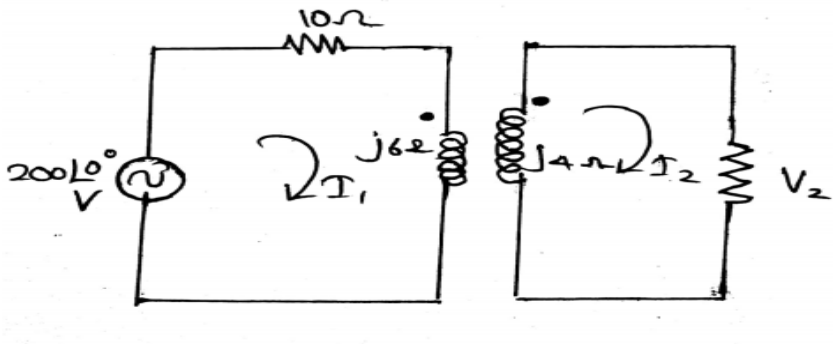
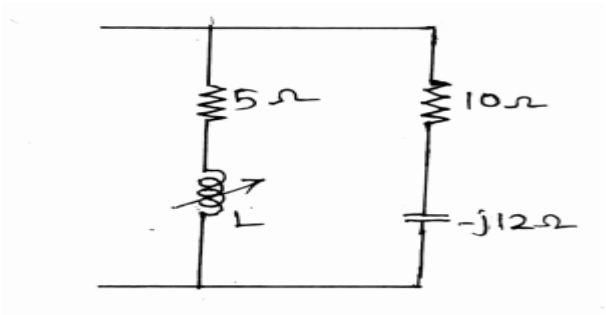
PART – A

Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	Define co-efficient of coupling. Give the expression for coefficient of coupling.	CO5	BTL 4	**Analyze**
2.	What is meant by Resonance?	CO5	BTL 5	**Evaluate**
3.	What is meant by anti resonance circuit? Illustrate the frequency response curve for Parallel RLC Circuit?	CO5	BTL 4	**Analyze**

4.	Write the expression for resonant frequency for series RLC Circuit.	CO5	BTL 1	**Remember**
5.	Express the term tuned circuits. Mention the different of tuned circuits.	CO5	BTL 5	**Evaluate**
6.	Draw the series resonant circuit. And also draw the frequency response characteristics.	CO5	BTL 1	**Remember**
7.	Illustrate the expression of maximum energy stored in (i) Inductor (ii) Capacitor.	CO5	BTL 5	**Evaluate**
8.	Discuss about the quality factor of a series resonant circuit.	CO5	BTL 2	**Understand**
9.	Define bandwidth of the resonant circuit.	CO5	BTL 1	**Remember**
10.	Illustrate the quality factor of a coil for the series resonant circuit consisting of R= 10 ohm, L= 0.1 henry and C= 10 microfarad.	CO5	BTL 3	**Apply**
11.	Define bandwidth of a resonant circuit.	CO5	BTL 1	**Remember**
12.	Describe the expression which relates the self and mutual inductance**.**	CO5	BTL 2	**Understand**
13.	Examine the maximum possible mutual inductance of two inductively coupled circuits with self inductance L_1 =16 H and L_2=4H.	CO5	BTL 3	**Apply**
14.	Define the terms (i) Mutual inductance (ii) Coefficient of coupling.	CO5	BTL 1	**Remember**
15	What is an antiresonance circuit? Create the frequency response of RLC Parallel Circuit.	CO5	BTL 6	**Create**
16.	Illustrate the expression for effective inductance of two series connected magnetically coupled coils.	CO5	BTL 2	**Understand**
17.	Two coupled coils with L_1=0.02 H, L_2=0.01 H and K=0.5 are connected in series aiding arrangement. Obtain the equivalent inductance.	CO5	BTL 3	**Apply**
18.	Define self-inductance and mutual inductance of a coil.	CO5	BTL 1	**Remember**
19.	What is meant by single tuned coupled circuits ?	CO5	BTL 5	**Evaluate**
20.	Define quality factor Q of a coil.	CO5	BTL 1	**Remember**
21.	Two identical coils with L=0.03H have a coupling coefficient of K=0.8.Find the mutual inductance and the equivalent inductance with the coils connected in series opposing mode.	CO5	BTL 3	**Apply**
22	What is meant by tuned circuits ? List some applications of tuned circuits.	CO5	BTL 1	**Remember**
23.	A resistor of 50 Ohm an inductor of 0.02 H and a capacitor of 5 µF are connected in series. Find the resonant frequency and power factor at resonance.	CO5	BTL 5	**Evaluate**
24.	Compare the properties of series and parallel resonant circuits.	CO5	BTL 4	**Analyze**
	PART-B			
1.	Explain briefly about the concept of parallel resonance. (13)	CO5	**BTL 4**	**Analyze**

2.	**(i)** Derive the expression for equivalent inductance of the parallel resonant circuit showninfig. (7) 	CO5	**BTL 6**	**Create**
	(ii) Create the mesh equations and obtain the conductively coupled equivalent circuit for the magnetically coupled circuit as shown in Figure. (6) 	CO5	**BTL 6**	**Create**
3.	Impedance Z_1 and $Z_2$are parallel and this combination is in series with an impedance Z3 connected to a 100V, 50 Hz ac supply. Z_1= (5-jXc) ohm, Z_2= (5+j0) ohm, Z_3= (6.25+j1.25) ohm. Calculate the value of capacitance such that the total current of the circuit will be inphase with the total voltage. Find the circuit current and power. (13)	CO5	**BTL 3**	**Apply**
4.	For a Series RLC Circuit (13) i) Derive the condition for resonance ii) Explain the frequency response and iii) Obtain quality factor and bandwidth.	CO5	**BTL 5**	**Evaluate**
5.	**(i)** Derive the resonance frequency 'f_r'for the circuit shown in Fig. (6) 	CO5	**BTL 4**	**Analyze**
	(ii) A series circuit with R=10 Ω, L=0.1 H and C=50 μF has an applied voltage V=50∟0^o V with a variable frequency. Find (**1)** the resonant frequency (**2)** the value of frequency at which maximum voltage occurs across inductor (**3)** value of frequency at which maximum voltage occurs across capacitor(**4)** quality factor of coil. (7)	CO5	**BTL 3**	**Apply**

6.	For a series RLC circuit, Derive the condition for resonance. Explain the frequency response and Obtain quality factor and bandwidth. (13)	CO5	**BTL 5**	**Evaluate**
7.	Draw the circuit diagram for Parallel Resonance Circuit. Describe how to derive Q factor and Bandwidth is obtained for parallel resonance circuit. (13)	CO5	**BTL 3**	**Apply**
8.	(i) For the given circuit the supply voltage V=100 Volts, Inductance L=50mH and Capacitance C=0.01μF. Find the resonant frequency in an ideal parallel LC Circuit. (7) (ii) What are coupled circuits? Sketch the frequency response of a single tuned circuit and give the application of tuned circuits. (6)	CO5 CO5	**BTL 2** **BTL 3**	**Understand** **Apply**
9.	Derive the mutual inductance and the coupling coefficient of the transformer with necessary illustration. (13**)**	CO5	**BTL 1**	**Remember**
10.	**(i)** Derive the expression for coefficient of coupling in terms of mutual and self inductances of the coils. (7) **(ii)** Two coupled coils have self inductances of L_1=100 mH and L_2=400 mH. The coupling coefficient is 0.8. Find M. If N1 is 1000 turns, what is the value of N_2? If a current i_1=2sin(500t)A through coil 1, find the flux $\phi 1$ and the mutually induced voltage V_2M. (6)	CO5 CO5	**BTL 4** **BTL3**	**Analyze** **Apply**
11.	(i) Draw the conductively coupled equivalent circuit for the given circuit in fig. and also find the voltage drop across 12Ω resistor. (7)  (ii)The number of turns in two coupled coils are500 turns and 1500 turns respectively. When 5A current flows in coil 1, the total flux in this coil is 0.6 x 10^{-3} wb and flux linking in second coil is 0.3 x 10^{-3} wb. Determine L_1, L_2, M and K. (6)	CO5 CO5	**BTL 3** **BTL 6**	**Apply** Create

12.	(i) A coil having an inductance of 100mH is magnetically coupled to another coil having an inductance of 900mH. The coefficient of coupling between the coils is 0.45. Calculate the equivalent inductance if the two coils are connected in 1) Series opposing and 2)Paralleloppposing. (4) **(ii)** For the circuit shown in fig. determine the voltage ratio V_1/V_2, which will make the current I_1equal tozero. (9) 	CO5 CO5	**BTL 3** **BTL 2**	**Apply** **Understand**
13.	**(i)** In the circuit shown in Fig. , Find the phasor voltage V_2. (7)  **(ii)** Two identical coupled coils in series has an equivalent inductance of 0.08 H and 0.0354 H when connected in series aiding and series opposing. Find the values of the inductance, mutual inductance and the co-efficient of coupling**.** (6)	CO5 CO5	**BTL 3** **BTL 3**	**Apply** **Apply**
14.	Analyze the value of L at which the circuit resonates at a frequency of 1000 rad/s in the circuit shown in Fig. (13) 	CO5	**BTL 4**	**Analyze**

15.	Two coupled coils of self inductance L1 = 2H and L2 = 4 H are coupled in (i) series aiding (ii) series opposing (iii) parallel aiding (iv) parallel opposing. If the mutual inductance is 0.5H, Find the equivalent inductance in each case. (13)	CO5	**BTL 3**	**Apply**
16.	Express the term self inductance and mutual inductance for the coupled circuits. (13)	CO5	**BTL 2**	**Understanding**
17.	What is magnetic coupling and its effect? Explain in detail in the concept of co-efficient coupling. (13)	CO5	**BTL 5**	**Evaluate**
	PART-C			
1.	Derive the mutual inductance and the coupling coefficient of transformer with necessary illustration. (15)	CO5	**BTL 5**	**Evaluate**
2.	A voltage v(t)=10sin ϖt is applied to a series RLC circuit. At the resonant frequency of the circuit, the maximum voltage across the capacitor is found to be 500V. The bandwidth is known to be 400 rad/s and the impedance at resonance is 100Ω. Find the resonant frequency. Also find the values of L and C of the circuit. (15)	CO5	**BTL 3**	**Apply**
3.	(i) What is meant by Resonance in AC Circuit ? In Series Resonance Explain the following terms (i) Circuit Diagram (ii) Impendence (iii) Phasor Diagram (iv) Reactance Curve (v) Variation of impedance (vi) Selectivity of Q-factor. (10) (ii) Determine the quality factor of a coil the values R=10Ω ; L=0.1 H and C= 10μF. (5)	CO5 CO5	**BTL 5** **BTL 5**	**Evaluate** **Evaluate**
4.	Two coupled coils with |L1 = 0.01H, L2 = 0.04 H and K = 0.6 can be connected in four different ways such as (i) series aiding, (ii) series opposing (iii) parallel aiding (iv) parallel opposing. Find the equivalent inductance in each phase. (15)	CO5	**BTL 3**	**Apply**
5.	Explain the phenomenon of resonance. Derive the formula for the resonance frequency of the series resonance circuits. And also obtain the capacitance and resonance curve. (15)	CO5	**BTL 5**	**Evaluate**

COURSE OUTCOMES:

CO 1	Ability to analyse electrical circuits.
CO 2	Ability to apply circuit theorems.
CO 3	Ability to analyse transients
CO 4	Ability to analyse three phase circuits.
CO 5	Ability to analyse frequency response of resonance and coupled circuits.